

Development and validation of analytical method for Irbesartan and atorvastatin by simultaneous equation spectroscopic method

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Abstract

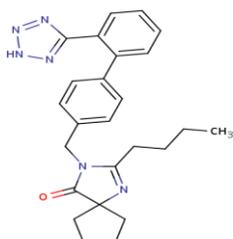
A simple, accurate and precise spectroscopic method was developed for simultaneous estimation of Irbesartan and atorvastatin in synthetic mixture using simultaneous equation Method. In this spectroscopic method, 226.00 nm and 246.00 nm wavelengths were selected for measurement of absorptivity. Both the drugs show linearity in a concentration range of 05-30 µg/ml at their respective λ_{max}. Accuracy, precision and recovery studies were done by QC samples covering lower, medium and high concentrations of the linearity range. The relative standard deviation for accuracy, precision studies were found to be within the acceptance range (<2%). The limit of determination was 0.033 µg/ml and 0.125 µg/ml for Irbesartan and atorvastatin, respectively. The limit of quantification was 0.1008 µg/ml and 0.3792 µg/ml for Irbesartan and atorvastatin, respectively. Recovery of Irbesartan and atorvastatin were found to be 99.75 % and 99.52% respectively confirming the accuracy of the proposed method. The proposed method is recommended for routine analysis since they are rapid, simple, accurate and also sensitive and specific by no heating and no organic solvent extraction.

Keywords: Irbesartan, atorvastatin, simultaneous estimation, Simultaneous equation method, analysis method.

1. Introduction

Irbesartan, an angiotensin II receptor antagonist is used mainly for the treatment of hypertension[1]. It is an orally active nonpeptidetetrazole derivative and selectively inhibits angiotensin II receptor type 2. Angiotensin II receptor type1 antagonists have been widely used in treatment of diseases like hypertension, heart failure, myocardial infarction and diabetic nephropathy. IUPAN name of Irbesartan is 2-butyl-3-({4-[2-(2H-1,2,3,4-tetrazol-5-yl)phenyl]phenyl}methyl)-1,3-diazaspiro[4.4]non-1-en-4-one.[2]

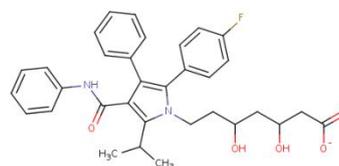
Figure 1: Structure of Irbesartan[3]



Irbesartan is white or almost white, crystalline powder. Solubility is given in practically insoluble in water, sparingly soluble in methanol, slightly soluble in methylene chloride.

Atorvastatin is used as lipid-lowering agents used in hyperlipidaemia condition. Atorvastatin selectively and competitively inhibits the hepatic enzyme HMG-CoA reductase.[4] As HMG-CoA reductase is responsible for converting HMG-CoA to mevalonate in the cholesterol biosynthesis pathway, this results in a subsequent decrease in hepatic cholesterol levels and decreases blood cholesterol level.

Figure 2: Structure of atorvastatin[5]



Atorvastatin is white or almost white, crystalline powder. Solubility is given in practically insoluble in water, soluble in methanol, slightly soluble in methylenechloride.

Hypertension frequently coexists with hyperlipidaemia and both are considered to be major risk factors for developing cardiac disease ultimately resulting in adverse cardiac events. This clustering of risk factors is potentially due to a common mechanism. Further, patient compliance with the management of hypertension is generally better than patient compliance with hyperlipidaemia. It would therefore be advantageous for patients to have a single therapy which treats both of these conditions with help of fixed dose combination of Irbesartan and atorvastatin.[6,7]

The review of literature regarding quantitative analysis of Irbesartan and atorvastatin revealed that no attempt was made to develop analytical methods for Irbesartan and atorvastatin. Some spectrometric methods and chromatographic methods have been reported for the estimation of the individual drugs. The focus of the present study was to develop and validate a rapid, stable, specific, and economic spectroscopic method for the estimation of Irbesartan and atorvastatin in Synthetic mixture.^(8,9)

2. Materials and Methodology

- Atorvastatin and Irbesartan were obtained as gift samples from S Kant pharmaceuticals and CTX life science Surat. Synthetic Mixture contains 20mg of Atorvastatin and 160mg of Irbesartan.
- A double beam UV/Visible spectrophotometer (Shimadzu model 2450, Japan) with spectral width of 2 nm, 1 cm quartz cells was used to measure absorbance of all the solutions.
- Spectra were automatically obtained by UV-Probe system software.
- An analytical balance (Sartorius CD2250, Gottingen, Germany) was used for weighing the samples.
- Sonicator(D120/2H, TRANS-O-SONIC)
- Class 'A' volumetric glassware were used (Borosilicite)

2.1 Standard solution of Irbesartan (IRB)

2.1.1 Preparation of stock solution of IRB

Accurately weighed quantity of Irbesartan 10 mg was transferred to 100 ml volumetric flask, dissolved and diluted up to mark with methanol to give a stock solution having strength of 100 μ g/ml.

2.1.2 Preparation of stock solution of ATR

Accurately weighed quantity of Atorvastatin 10mg was transferred to 100 ml volumetric flask, dissolved and diluted up to mark with methanol to give a stock solution having strength of 100 μ g/ml.

2.1.3 Preparation of standard mixture solution

From the stock solution of IRB take 1.6ml and from stock solution of ATR take 0.2ml and transferred in to 10ml volumetric flask and diluted up to mark with methanol to give a solution having strength of IRB was 16 μ g/ml and ATR was 2 μ g/ml.

2.1.4 Preparation of test solution

From the stock solution of IRB take 1.6ml and from stock solution of ATR take 0.2ml and transferred in to 10ml volumetric flask and diluted up to mark with methanol to give a solution having strength of IRB was 16 μ g/ml and ATR was 2 μ g/ml.

2.2 Calibration curves for Irbesartan

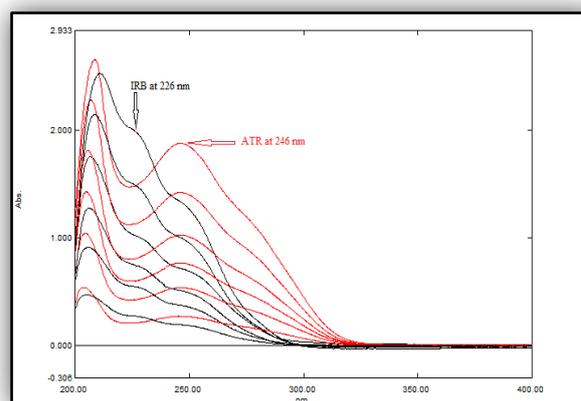
Pipette out 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 ml of the stock solution of Irbesartan and atorvastatin (100 μ g/ml) into a series of 10ml volumetric flasks and the volume was adjusted to mark with methanol and measured absorbance at 226.00nm and 246nm. The graph was plotted of absorbance versus respective concentration of Irbesartan and atorvastatin. Linearity range of IRB and ATR was found with correlation co-efficient.

2.3 Development and validation of spectroscopic simultaneous equation method

2.3.1 Selection of wavelength and method development for determination of Irbesartan and Atorvastatin

The standard solution of IRB and ATR were scanned separately between 200-400nm, and IRB showed absorbance maxima at 226.00 nm and ATR at 246.00 nm. (Figure 3)

Figure 3: Overlain zero order spectra of IRB and ATR (8:1) ratios, respectively



3. Results and Discussion

3.1 Validation Parameters [10]

1. Linearity and Range

The Zero order (fig.3) showed linear absorbance at 226.00 nm for IRB (05-30 μ g/ml) and 246.00nm for ATR (5-30 μ g/ml) with correlation coefficient (r^2) of 0.9994 and 0.9993 for IRB and ATR, respectively.

This method obeyed Beer's law in the concentration range 05 - 30 µg/ml and 5-30 µg/ml for IRB and ATR, respectively. (Table 1)

Correlation coefficient (r^2) for calibration curve of IRB and ATR was found to be 0.9994 and 0.9993, respectively (figure 4 and 5)

The regression line equation for IRB and ATR are as following,

$$y = 0.0983x - 0.2385 \text{ for IRB} \quad (1)$$

$$y = 0.0642x - 0.0695 \text{ for ATR} \quad (2)$$

Table 1: Calibration data for IRB and ATR at 226.00 nm and 246.00 nm respectively *(n=6)

Sr. No	Conc. (µg/ml)		Absorbance* (226.00nm) ±SD IRB	Absorbance* (246.00nm) ±SD ATR
	IRB	ATR		
1	05	05	0.3708±0.0023	0.2672±0.0015
2	10	10	0.7460±0.0020	0.5674±0.0017
3	15	15	1.2171±0.0013	0.8872±0.0018
4	20	20	1.6972±0.0015	1.1974±0.0012
5	25	25	2.2225±0.0013	1.5232±0.0022
6	30	30	2.7653±0.0025	1.8772±0.0016

Figure 4: Calibration curve for IRB at 226.00 nm

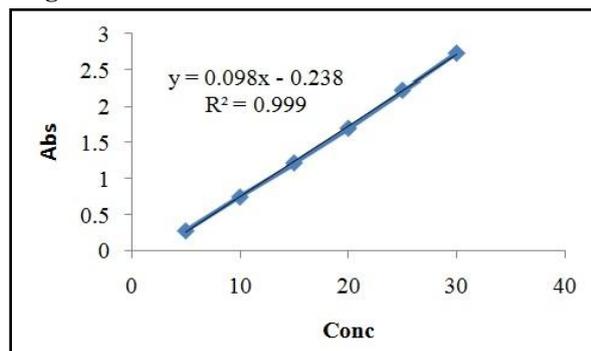
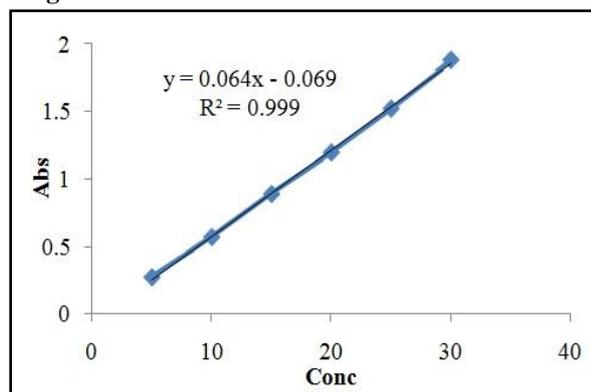


Figure 5: Calibration curve for ATR at 246.00 nm



3.2. Precision

I. Intraday precision

The precision of the developed method was assessed by analyzing combined standard solution containing three different concentrations 05, 15, 30 µg/ml for IRB and 05, 15, 30 µg/ml ATR. Three replicate (n=3) each on same day. Intraday precision data presented in Table 2.

This % RSD value was found to be less than ±2.0 indicated that the method is precise.

Table 2: Intraday precision data for estimation of IRB and ATR*(n=3)

Conc. (µg/ml)		IRB Abs.* ± % RSD ±% RSD Abs. ±% RSD IRB	ATR Abs.* ± % RSD
IRB	ATR		
05	05	0.372±0.45	0.266±0.57
15	15	1.211±0.21	0.884±0.92
30	30	2.763±0.52	1.877±0.23

II. Interday precision

The precision of the developed method was assessed by analyzing combined standard solution containing three different concentrations 05, 15, 30 µg/ml for IRB and 05, 15, 30 µg/ml ATR triplicate (n=3) per day for consecutive 3 days for inter-day precision. Interday precision data presented in Table 3

These % RSD value was found to be less than ±2.0 indicated that the method is precise.

Table 3: Interday precision data for estimation of IRB and ATR*(n=3)

Conc. (µg/ml)		IRB Abs.* ± % RSD RSD ± % RSD Abs. ± % RSD IRB	ATR Abs.* ± % RSD
IRB	ATR		
05	05	0.377±0.55	0.270±0.56
15	15	1.215±0.25	0.887±0.17
30	30	2.786±0.85	1.881±0.36

3.3. Accuracy

Accuracy of the method was determined by recovery study from synthetic mixture at three levels (80%, 100% and 120%) of standard addition. The % recovery values are tabulated in Table 4 & 5.

Percentage recovery for IRB and ATR by this method was found in the range of 100.07 to 100.43% and 99.21 to 100.55%, respectively,

The value of % RSD within the limit indicated that the method is accurate and percentage recovery shows that there is no interference from the excipients.

Table 4: Recovery data of IRB*(n=3)

Conc. of IRB from formulation (µg/ml)	Amount of Std. IRB added (µg/ml)	Total amount of IRB (µg/ml)	Total amount of IRB found (µg/ml)* Mean ± SD	% Recovery (n=3)	% RSD IRB
8	6.4	14.4	12.81±0.022	100.07%	0.32%
8	8.0	16.6	16.07±0.013	100.43%	0.68%
8	9.6	17.6	19.22±0.045	100.10%	0.28%

Table 5: Rsecovery data of ATR*(n=3)

Conc. of ATR from formulation ($\mu\text{g/ml}$)	Amount of Std. ATR added ($\mu\text{g/ml}$)	Total amount of ATR ($\mu\text{g/ml}$)	Total amount of ATR found ($\mu\text{g/ml}$)* Mean \pm SD	% Recovery (n=3)	% RSD ATR
1	0.8	1.8	1.81 \pm 0.021	100.55%	0.84%
1	1.0	2.0	2.00 \pm 0.036	100.50%	0.22%
1	1.2	2.2	2.19 \pm 0.20	99.21%	0.35%

3.4. Limit of detection and quantitation

The LOD for IRB and ATR was conformed to be 0.033 $\mu\text{g/ml}$ and 0.125 $\mu\text{g/ml}$, respectively.

The LOQ for IRB and ATR was conformed to be 0.1008 $\mu\text{g/ml}$ and 0.379 $\mu\text{g/ml}$, respectively.

The obtained LOD and LOQ results are presented in Table 6.

Table 6: LOD and LOQ data of IRB and ATR *(n=10)

Conc. ($\mu\text{g/ml}$)		Avg.abs* \pm SD (226.00nm) IRB	% RSD	Avg.abs* \pm SD (246.00nm) ATR	% RSD
IRB	ATR	0.371 \pm 0.0007	1.93	0.270 \pm 0.0006	0.45
LOD ($\mu\text{g/ml}$)		0.033		0.125	
LOQ ($\mu\text{g/ml}$)		0.1008		0.3792	

3.5. Robustness and Ruggedness

The obtained Ruggedness and Robustness results are presented in table 6.3.8

The % R.S.D was found to be 0.12 – 0.84 % for IRB and 0.11 – 0.74 % for ATR.

These %RSD value was found to be less than \pm 2.0 indicated that the method is precise.

No significant changes in the spectrums were observed, proving that the developed method is rugged and robust.

Table 7: Robustness and Ruggedness data of IRB and ATR *(n=3)

Condition	Conc. ($\mu\text{g/ml}$)	Different Instrument		Different Stock Solution Preparation	
		UV-2450	UV-1800	Stock-1*	Stock-2*
Irbesartan Mean (n=3) \pm % RSD	05	0.376 \pm 0.32	0.374 \pm 0.47	0.376 \pm 0.12	0.373 \pm 0.82
	15	1.215 \pm 0.56	1.216 \pm 0.22	1.215 \pm 0.42	1.216 \pm 0.56
	30	2.763 \pm 0.23	2.765 \pm 0.84	2.764 \pm 0.21	2.763 \pm 0.32
Atorvastatin Mean(n=3) \pm %RSD	05	0.271 \pm 0.54	0.269 \pm 0.43	0.272 \pm 0.42	0.270 \pm 0.11
	15	0.885 \pm 0.66	0.882 \pm 0.33	0.884 \pm 0.15	0.885 \pm 0.33
	30	1.879 \pm 0.16	1.878 \pm 0.13	1.882 \pm 0.52	1.884 \pm 0.74

Stock-1:- 10 mg dissolve in 100 ml Methanol

Stock-2:- 50 mg dissolve in 250 ml Methanol

3.6 Application of the proposed method for analysis of IRB and ATR in combined capsule dosage form

All the excipients were mixed in 10ml volumetric flask and sonicate for 15min. make up the volume with Distilled Water. The solution was filtered

through Whatman filter paper No. 42.

Finally the solution had concentration 1600 $\mu\text{g/ml}$ for IRB and 200 $\mu\text{g/ml}$ for ATR. from that pipette out 0.1ml in 10 ml volumetric flask and volume was made up to mark with methanol to obtain final solution containing 16 $\mu\text{g/ml}$ of IRB and 2 $\mu\text{g/ml}$ of ATR. A zero order spectrum of the resulting solution was recorded and processed to first derivative spectra. A spectrum of the sample solution was recorded and the absorbance at 226.00 nm and 246.00 nm were noted for estimation of IRB and ATR, respectively. The concentrations of IRB and ATR in formulation were determined using the corresponding calibration graph.

Table 8: Analysis data of commercial formulation*(n=3)

Sr. No	Drug	Formulation ($\mu\text{g/ml}$)	% Assay* \pm SD	USP limit (%)
1	IRB	16.0	99.75 \pm 0.22	98-102%
2	ATR	2.0	99.52 \pm 0.56	98-102%

Summary of validation Parameter

Table 9: Summary of validation parameters

Sr. No.	Parameter	Irbesartan	Atorvastatin
1	Wave length Max.	226.00 nm	246.00 nm
2	Linearity ($\mu\text{g/ml}$) (n=6)	5 to 30 $\mu\text{g/ml}$	5 to 30 $\mu\text{g/ml}$
3	Regression equation	y = 0.0983x - 0.2385	y = 0.0642x - 0.0695
4	Correlation coefficient (r^2)	0.9994	0.9993
5	Accuracy (%Recovery) (n=3)	100.26	100.13
6	Precision Intra-day (%RSD)(n=3)	0.21-0.52	0.23-0.92
	Inter-day (%RSD)(n=3)	0.25-0.85	0.17-0.56
7	LOD ($\mu\text{g/ml}$) (n=10)	0.033	0.125
8	LOQ ($\mu\text{g/ml}$) (n=10)	0.1008	0.3792
9	Robustness and Ruggedness (%RSD)	0.12-0.84	0.11-0.73
10	Assay	99.75 \pm 0.22	99.52 \pm 0.56

4. Conclusion

A new, Simultaneous Equation method has been developed for estimation of Irbesartan and Atorvastatin in synthetic mixture. The method was validated by employment of ICH(18) guidelines. The validation data is indicative of good precision and accuracy, and prove the reliability of the method.

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